Analysis of Fatigue Crack Growth From Countersunk Fastener Holes[1]

by

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Abstract

This paper will describe the objectives and approach for a new research program to develop and experimentally verify life-prediction schemes for fatigue cracks located at countersunk fastener holes. Although the countersink is a common source of cracking in aircraft joints, its complex three-dimensional geometry has limited advancement of stress intensity factor solutions needed for fracture mechanics evaluation of crack growth. This effort will catalog existing solutions, which will then be subjected to experimental evaluation. The experimental approach will be to conduct fatigue tests with transparent polymer specimens that enable in situ measurement of the shape and size of fatigue cracks that develop at countersunk holes. The transparent test material allows measurement of the shape and growth of internal crack dimensions that are not readily apparent in metal specimens. These experimental data will characterize the natural shapes of cracks that form at countersunk fastener holes, and guide subsequent numerical analyses of crack shapes expected to occur in service. The fatigue crack growth data will then be used to evaluate fracture mechanics life predictions based on existing stress intensity factor solutions. These numerical solutions will then be modified and extended as necessary. It is expected that this research will result in a set of experimentally verified stress intensity factor solutions for various practical countersunk hole crack configurations.

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